United States
Department of
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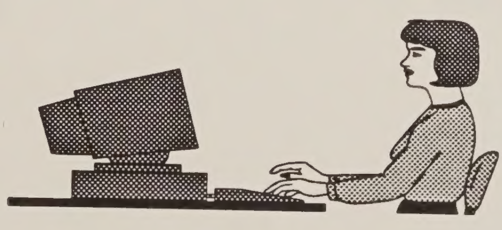
Forest Service

Forest Pest
Management

Davis, CA

Meteorological Data Reduction METDAT Version 1.0

User Documentation



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Meteorological Data Reduction
METDAT
Version 1.0

User Manual

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INTRODUCTION

The data reduction utility METDAT enables interpretation of raw meteorological data from the USDA Forest Service EMCOT Weather Station portable towers (Ekblad et al. 1990) into statistical averages for input into FSCBG or graphical presentation packages. The structure of the data logger data files are incorporated into the program to read and interpret the raw data within a simple user interface. Meteorological statistics are then generated for the time intervals desired. The accompanying 3-1/2 inch diskette contains the program for operation on a personal computer.

METDAT OPERATION

METDAT may be initiated with the command

METDAT < cr >

followed by a carriage return < cr > or enter keystroke. The program must be in the current subdirectory, or accessed through the DOS PATH statement. Alternately, METDAT may be initiated with a filename on the command line

METDAT metrawfile < cr >

where metrawfile is the name of a comma-delineated ASCII file containing the data logger recorded data (as from Thompson 1991). By convention this file extension is always DAT.

METDAT is configured for operation on CRT color monitors; thus, LCD gray-scale monitors may fail to represent some menus adequately. To overcome this effect the user may initiate METDAT in a black-and-white mode by including a separate character string ("/g") on the command line to indicate operation on a gray-scale monitor:

METDAT /g < cr >

METDAT metrawfile /g < cr >

All operations will then commence in black and white only.

In succession, METDAT makes the following screen entries:

Enter name of met raw data file

will be asked if metrawfile is not included on the command line. This file should be in the same subdirectory as METDAT. If an incorrect file name is entered, the error message

Unable to open metrawfile.DAT

will appear. Subdirectory contents should be examined to select a correct file name.

Checking metrawfile.DAT

will be shown as the program reads through the data file (recorded times in HoursMinutes will be displayed to indicate that METDAT is reading the data file).

Time limits are between xxxx and yyyy

will indicate what the actual time limits are in the data file. METDAT will generate ten-minute averages of meteorological data, beginning with a complete time recorded by the data logger (a time that includes temperature, relative humidity and wind data).

Some of the met raw data files from Thompson (1991) appear to be corrupted at the beginning of the file. METDAT attempts to overlook this data by checking for consistency from the end of the file backwards to the front.

Enter time to begin averaging

will be asked to select the first ten-minute interval for averaging. The time selected is the time at the beginning of the interval, and must be within the time limits given previously.

Enter number of averages to compute

will be asked to indicate how many ten-minute averages should be performed. The averages are subsequently displayed on the screen, and read into a comma-delineated ASCII file (with the extension AVE) for transfer to statistical and graphical packages such as Lotus 1-2-3 or Harvard Graphics. The screen will display the first ten averages. Once the message

zzzz Entries written to metrawfile.AVE

appears, the user may examine this file, on the screen, with the aid of the cursor up or down arrow keys. A carriage return < cr > or enter will exit the program.

The screen presents the column results (duplicated in the created ASCII file metrawfile.AVE but without the units) as follows:

Time	The HoursMinutes designation from the data logger for the time at the beginning of the ten-minute averaging interval
Wind Speed (in meters/second)	The average horizontal wind speed in each ten-minute interval (20.0 feet above the ground)
Wind Direction (in degrees)	The average wind direction in each ten-minute interval (20.0 feet above the ground)
Sigma A (in radians)	The azimuth standard deviation of the horizontal wind speed
Sigma E (in radians)	The elevation standard deviation of the vertical wind speed
Temperature Bottom (in deg C)	The average temperature at the lower temperature sensor (4.0 feet above the ground)
Temperature Top (in deg C)	The average temperature at the upper temperature sensor (20.0 feet above the ground)
Relative Humidity (in percent)	The average relative humidity (20.0 feet above the ground)

In all cases Sigma E has been set equal to one-third of Sigma A. This approach is a compromise for the inherent unreliability of the propeller anemometer to detect vertical wind speed (Bowers 1991).

STATISTICS

Mean horizontal wind speed $\overline{U}$ is determined from the equation

$$\overline{U} = \frac{1}{N}\Sigma\, U_i$$

where the index i denotes each data logger entry for wind speed in the ten-minute interval, and N denotes the total number of data points considered (typically N = 600 for data recorded every second).

Mean vertical wind speed $\overline{W}$ is determined by the equation

$$\overline{W} = \frac{1}{N}\Sigma\, W_i$$

where the data logger entries for W-component are used.

Mean wind direction $\overline{\Theta}$ is found from the unit vector approach (Haugen 1963) by defining

$$\overline{X} = \frac{1}{N}\Sigma \cos \Theta_i$$

$$\overline{Y} = \frac{1}{N}\Sigma \sin \Theta_i$$

to obtain

$$\overline{\Theta} = \arctan\left[\frac{\overline{Y}}{\overline{X}}\right]$$

where, internally, METDAT uses the ATAN2 intrinsic function defined on the interval -180 degrees to 180 degrees . This procedure eliminates any erroneous behavior in the wind direction because of cycling of the direction angle every 360 degrees. It is anticipated that the meteorological tower will be set in the field so that North corresponds to $\overline{\Theta} = 0$ degrees. Thus, $\overline{\Theta}$ determined here is the wind direction from North, with a positive value indicating clockwise. Other tower positions will change the zero position of the wind direction accordingly.

Azimuth standard deviation σ_A is then found from the equation (Haugen 1963) as

$$\sigma_A = \arcsin\left[\left(1 - \overline{X}^2 - \overline{Y}^2\right)^{1/2}\right]$$

while elevation standard deviation σ_E is found from the equation

$$\sigma_E = \frac{1}{3}\sigma_A$$

to avoid propeller anemometer signal difficulties at low wind speeds.

Finally, average temperature $\overline{T}$ and relative humidity $\overline{R}$ are found from the equations

$$\overline{T} = \frac{1}{N}\Sigma\, T_i$$

and

$$\overline{R} = \frac{1}{N}\Sigma\, R_i$$

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